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UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
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## INFORMATION CIRCULAR

# SAFETY WORK OF THE BUREAU OF MINES AND SOME OF ITS RESULTS

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BY

D. HARRINGTON

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## UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

# SAFETY WORK OF THE BUREAU OF MINES AND SOME OF ITS RESULTS[1]

By D. Harrington[2]

## INTRODUCTION

Before the present century there existed a fairly persistent demand for the establishment of a Federal Department of Mines, but relatively little was done about it until a considerable number of very serious coal-mine disasters in 1906, 1907, 1908, and 1909 created what might almost be termed a national scandal and virtually forced the Federal Government to take action to try to solve the problem of the cause and prevention of such disastrous occurrences. Instead of a Department of Mines, the mining people had to accept a bureau, which was created on July 1, 1910; and while the Bureau of Mines was given numerous functions, unquestionably the promotion of safety in the mineral industries was and continues to be one of its main "jobs."

The Bureau's organic act was approved in 1910 and amended in 1913. Both the original and amended acts indicated that promoting the health and safety of the mine workers constituted the chief function of the Bureau, and that this was the construction placed on its activities by those put in charge in 1910 is shown very definitely by the fact that as soon as the Bureau came into existence on July 1, 1910, both health and safety activities were started in its Mine Accidents Division. Before the end of the first fiscal year (June 30, 1911) 6 mine safety stations had been established in various parts of the United States, and 6 mine safety cars had been put into the field; by October 1910 first-aid-training work was being done in mining regions. The Bureau was able to function so promptly in its safety work largely because sections of the Geological Survey, which had been doing some coal-mine safety work since 1907 or 1908, were transferred into the Bureau when it began to operate in July 1910. On October 30, 1911, a National First-Aid Meet was held at Pittsburgh, Pa., at which first aid and mine rescue were demonstrated. During the fiscal year 1910-11, the first year of the Bureau's existence, 509 persons were given certificates indicating completion of the Bureau's training course in first aid.

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Within a few months of the creation of the Bureau, an arrangement was made with the United States Public Health Service by which doctors of that organization could cooperate with engineers of the Bureau in investigations to improve the health of persons engaged in the mining and allied industries. A similar arrangement is in effect at the present time.

## FUNCTIONS AND SCOPE OF THE SAFETY WORK OF THE BUREAU OF MINES

The Bureau pursues two general lines of investigation - field and laboratory studies designed to bring about safer and more healthful conditions among workers in the mining and allied industries and the study of new and improved methods for mining, treatment, and utilization of the numerous mineral materials essential to present-day human welfare. The mining, quarrying, metallurgical, and petroleum industries of this country give more or less direct employment to well over 2,000,000 persons; if their dependents are included, the welfare of probably 10,000,000 persons is fairly definitely affected by the Bureau's work of various kinds.

The Bureau has no legal authority to enter mines or other establishments or to enforce its recommendations as to health, safety, or efficiency, the regulation of mining and other mineral industries being vested in the 48 States. The Bureau therefore relies upon the cooperation of the mining industry and of the various State mining and other departments (chiefly through educational work, such as the issuance of published papers and pamphlets, the giving of first aid and other safety training courses, etc.) to make its findings and recommendations effective in trying to improve conditions not only as to health and safety but also as to efficiency and conservation.

Those who have been engaged for any considerable period in the field activities of the Bureau of Mines in health and safety have long believed that nearly all matters pertaining to health, safety, and efficiency in the mineral industries are so interrelated that any attempt to engage in any one without paying due attention to the others is almost certain to be ineffective if not absolutely disastrous. Hence, Bureau of Mines employees in the Health and Safety Branch are prone to associate all three of these phases of mining whenever any one of them is brought up for discussion or action; and most of the hundreds of pamphlets issued by the health and safety workers of the Bureau of Mines since its inception in 1910 have recognized this interdependence in some manner.

With no authority to enter mines or other plants to obtain information or to enforce its suggestions or recommendations, the main function of the branch is educational, and in this the utmost effort is expended to obtain and maintain close cooperation with workers, employers, State inspection and enforcement organizations, and numerous other agencies engaged in promoting health and safety.

## ORGANIZATION AND METHODS

The Health and Safety Branch at present consists of two divisions - the Safety Division, with 82 employees, and the Health Division, with 17 persons.

a total of 99 for the branch out of a total of about 725 for the Bureau as a whole.

The staff of the Safety Division includes 29 safety instructors engaged chiefly in giving first-aid and mine rescue training to the nearly 2,000,000 persons employed in the mining and allied industries in the 48 States, more than 600,000 of whom are in coal mining alone; 28 engineers who do some first-aid and mine rescue training but who should be engaged in strictly engineering work (making safety examinations and reports on mines and mining plants, giving accident-prevention courses to mine workers and officials engaged in mining, and numerous other similar types of work); 18 clerks; and 7 others (cooks on mine rescue cars, laborers, etc.). The Safety Division work is directed from 14 safety stations (San Francisco, Calif.; Seattle, Wash.; Phoenix, Ariz.; Salt Lake City, Utah; Denver, Colo.; McAlester, Okla.; Duluth, Minn.; Vincennes, Ind.; Birmingham, Ala.; Jellico, Tenn.; Norton, Va.; Pittsburgh, Pa.; Wilkes-Barre, Pa.; and Juneau, Alaska), all of them being provided with suitable complement of mine rescue equipment, etc. In addition, three field offices were established relatively recently to handle petroleum safety work (Dallas, Tex.; Bartlesville, Okla.; and Houston, Tex.).

The 82 employees had the following funds alloted to them in the fiscal year 1939: Salaries, $213,560; travel, $45,120; supplies, $18,500; contracts, $14,464; miscellaneous, $4,120; total $295,764. This sum is available in the present fiscal year (1938-39) for the Bureau of Mines field safety work for the approximately 2,000,000 persons engaged in the mineral industries (bituminous coal, anthracite, metal mining, nonmetallic mineral mining, quarries, cement plants, petroleum plants of all kinds, metallurgical plants, etc.) in the 48 States; the State of Pennsylvania allots more than $250,000 for its inspection force for approximately 200,000 persons employed in coal mining alone in that one State. The total working allotment for the Bureau of Mines is about $2,300,000.

The Health Division personnel of 17 persons (2 in Washington and 15 in Pittsburgh, Pa.) devotes its time chiefly to laboratory investigations into harmful gases and dusts and testing dust respirators, gas masks, etc., as well as to the dissemination of information of various kinds looking to the prevention of ill health and accidents in the mineral industries. Workers of the Health Division also do considerable investigative work in mines and tunnels every year. The funds available to the Health Division in the fiscal year 1939 total $43,869, of which $37,380 goes to salaries, $2,000 to travel, $2,489 to supplies, and $2,000 to fixed charges and miscellaneous activities.

The total amount available for the operation of the Health and Safety Branch of the Bureau of Mines for the fiscal year 1939 is $339,633.

The funds for the Health and Safety Branch are obtained from Congress from the allotment designated "Operating Mine Rescue Cars and Stations and Investigation of Mine Accidents"; the total for this allotment for the fiscal year 1939 is $635,000, of which approximately $340,000 constitutes the working funds of the Health and Safety Branch and the remainder is devoted chiefly to research and laboratory work of a health and safety nature, in the testing of explosives, electrical equipment, etc., in the Technologic Branch of the Bureau, and for administrative purposes.

## EDUCATIONAL WORK

In its various educational activities the engineers and safety instructors of the Safety Division annually come into fairly close personal contact with approximately 300,000 persons in the mineral industries; in the past fiscal year it is estimated that the approximately 60 engineers and safety instructors had fairly close contact with at least 500,000 persons in these industries.

The first-aid training work constitutes the most intimate and in some ways the most effective method of putting before the mining industry (both employer and employee) up-to-date health and safety data; in other words, the first-aid training course as now given is excellent accident-prevention "propaganda", and probably its most valuable feature is that it reaches workers in large numbers, over 100,000 now taking the course annually. More than 1,000,000 mining people have taken this course; it is estimated that through it at least 200 lives are saved annually, and probably at least 10,000 nonfatal accidents are prevented from occurring in the mining and allied industries because of the "safety consciousness" given to those who take the course of instruction as taught by present-day Bureau of Mines methods and instructors. During the past fiscal year the first-aid training was given in 790 mining communities in 38 States, 102,698 persons receiving certificates for having completed the course.

Naturally, the Bureau of Mines, immediately upon coming into existence with a mandate from Congress to try to stop mine disasters, addressed itself intensively to the matter aiding in preventing loss of life in mine disasters, and it was found advisable in this as well as in all other phases of safety work to attack the problem from several points of view, as safety work does not thrive at all well when all the "eggs are in one basket." An experimental coal mine was established near Pittsburgh, Pa., and in a short time valuable information was obtained as to how coal-mine explosions and fires were caused, and many data were obtained as to feasible methods of preventing them or of limiting their extent and destructiveness if they should start. Many other laboratory studies were made, and some continue to be made with regard to mine-disaster limitation or prevention, such as investigations about explosives, electrical and other equipment, miners' lamps, respiratory equipment, and ventilation; field studies including all of the above as well as other matters pertaining to explosions and other mine disasters and their prevention were and still are carried on in essentially every mining section of the United States.

That the result has been satisfactory is shown by the fact that, chiefly through use of the data obtained largely by the Bureau of Mines and conveyed to the mining industry by demonstrations, talks, meetings, published papers and pamphlets, and otherwise, the coal-mining industry has reduced the occurrence of widespread explosion disasters almost to the vanishing point,

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though the record of the past 2 years has not been as good as it should have been. The following statistics indicate the decline in occurrence of major coal-mine disasters, those in which five or more lives are lost. From 1906 to 1910, inclusive (or just before the Bureau of Mines got into action), 84 major disasters occurred in the coal mines of the United States, with 2,386 fatalities, an average of 17 major disasters and 477 fatalities per year. From 1933 to 1937, inclusive, there were 18 major coal mine disasters with 202 fatalities, an average of 3.6 major disasters and 40 fatalities per year, which represent a reduction of more than 78 percent in the number of disasters and about 92 percent in fatalities brought about by them.

Similarly, fires and other major disasters in metal mines have been reduced to almost nothing by the metal-mining industry, largely as a result of applying the information obtained from studies made and data issued by the Bureau of Mines in its investigations on mine fires, ventilation, etc., in connection with the numerous very serious metal-mine fires that occurred prior to 1925. From what has been accomplished in reducing the number of widespread or major disasters in mines, it is apparent that the Bureau of Mines, in cooperation with the mineral industries, has successfully solved the main problem presented to it in 1910, namely, the reduction of mine disasters by ascertaining the causes and how to remedy or prevent them.

The main objective in mine safety work is the prevention of accidents to those who work in and around mines; hence, the workers themselves manifestly must be "reached" with accident-prevention information and, therefore, must be educated in safety, as very few people now believe that safety, whether in mining or elsewhere, can be achieved by "strong-arm" methods, such as the piling up of laws and regulations, though a reasonable number of sensible laws and regulations can aid. Education and supervision (the latter largely educational) are the foundation for the achievement of safety in mining, and the Bureau is now using and for some years has used numerous educational eans to teach safety - the first-aid and mine rescue training courses being but one of them.

The Bureau's first-aid and mine rescue training has been given to more than 13,000 persons in the cement industry, more than 835,000 in coal mining, 130,000 in metal mining, 30,000 in metallurgical plants, about 15,000 in onmetallic mining, 87,000 in the petroleum industry, about 6,000 in tunnel ork, and about 29,000 in miscellaneous activities related in some way to ines or the mineral industries. This training has also been given to about ,900 persons not connected with the mineral industries.

To encourage persons proficient in first-aid work or in the teaching of t, the Bureau has issued nearly 9,500 first-aid instructors' certificates, hich are much in demand as the holders very often are given a preferential ight to obtain or retain employment. These certificates have been issued o residents of 44 States.

Up to June 1, 1938, 1,910 mines and plants in the mining and allied inustries had been given 100-percent training certificates indicating that very person in the mine or plant had taken the full Bureau of Mines first-aid training course. Some mining companies have had these certificates annually for 10 or more consecutive years - 256 100-percent certificates were issued to mines or plants in the fiscal year 1938, the total trained being nearly 46,000. This 100-percent first-aid training has been given in 41 States to a total of nearly 390,000 persons.

To those interested in knowing correct and advisable procedure in case of a mine disaster, the Bureau has given a course of training in advanced mine rescue and recovery work, and to July 1, 1938, the full course had been given to nearly 3,200 persons in 25 States.

Every year the Bureau's field safety workers assist or in some manner participate in 50 or more first-aid and mine-rescue contests or meets; these meets are now staged by organizations connected with the mineral industries to stimulate safety in general as well as first-aid and mine rescue work in particular. In the fiscal year ended June 30, 1938, the Safety Division workers of the Bureau of Mines aided in 74 of these meets staged in 21 States and the Province of British Columbia, Canada; about 7,400 persons participated as contestants and about 113,000 persons were present as spectators.

To "put over" to mining people, particularly such supervising officials as superintendents, foremen, fire bosses, face bosses, etc., the safety lessons learned and data assembled by the Bureau of Mines, an accident-prevention course has been devised, and since its inauguration nearly 7,700 mining men, chiefly officials, have completed the course, which requires several weeks of instruction; about 4,700 persons have taken part of the course but failed to take all of it. This accident-prevention course has been given in 16 States.

Every year the Safety Division of the Bureau stages safety exhibits or demonstrations at conventions, State or county fairs, and similar assemblages; in the fiscal year ended June 30, 1938, 50 of these exhibits or demonstrations were made in 13 States, and it is estimated that at least 235,000 spectators viewed them.

To assist in keeping safety propaganda not only before the workers and the officials at mines or plants but also to enlist the interest of their families, the Bureau has for nearly 15 years established what might be termed safety clubs in the form of chapters of the Holmes Safety Association. In all, 472 of these Holmes Safety Chapters have been established in 28 States and 10 new ones were organized in the past fiscal year.

To bring safety lessons to the workers in most impressive form requires a method that enlists not only their instincts of self preservation but also amuses or at least interests them in some manner. The best method of approach undoubtedly is through motion pictures, more particularly sound pictures. The Bureau has relatively little money available for the purpose, so three "home-made" sound films depicting phases of coal-mine safety have been made. They are so popular that the Bureau has neither enough films nor projectors to even approach satisfying the demands for them.

Attendance at safety meetings, chiefly at mines or in mining communities, is one of the important functions of the Bureau's safety employees, and usually they participate actively by reading papers, making safety talks, etc. In the fiscal year ended June 30, 1938, the Safety Division employees attended 612 safety gatherings of various kinds, at which there was an estimated attendance of 99,000 persons. These meetings are held in addition to instructional classes of various types. In the past 6 years the field workers of the Safety Division have attended about 4,100 safety meetings in 43 States and the Province of British Columbia.

Since the Bureau was created, one of the important activities of the field safety personnel has been attendance at mine accidents and disasters; the engineers prepare reports on them after investigating to ascertain the causes and possible methods of prevention. In the past fiscal year 29 mine explosions and 26 mine fires in 24 States were investigated by members of the Safety Division and 55 miscellaneous accidents in 20 States were reported. Every year a report is published containing essential data on explosions, fires, and other accidents about which information has been obtained, compiled by Bureau personnel, and giving the causes as well as the probable feasible methods of preventing or at least reducing the seriousness of these mishaps of various kinds.

Annually the field workers make scores of underground inspections investigating health or safety conditions and later submit written reports, giving the ascertained data with recommendations as to improvement. In the past fiscal year, 213 such reports were made in 31 States. These reports include a multiplicity of details on underground health and safety conditions and practices in essentially all kinds or types of mining operations in the United States. In the investigations or visits preliminary to the making of these reports, the field men not only observe and learn many details on health and safety in mining, but also transmit to the mining people much health and safety information obtained elsewhere incident to making investigations.

Another essential service that the field workers of the Safety Division give to the industry is the inspection of privately owned mine rescue stations and their equipment; they make oral recommendations during the inspection and usually supplement these with written reports that generally (though not invariably) find the respiratory equipment in unsafe condition, often because it has not been used or inspected much during the past several years due to the comparative lack of fires and explosions. Twenty-nine such investigations and reports were made in 8 States during the past fiscal year.

In trying to give the mining industry as much as possible of the safety and health information obtained by the Safety Division, 62 manuscripts of various kinds were prepared for publication by 20 members of the division; 41 were issued by the Bureau, and about 35 (some of which were pending from the previous fiscal year) were published in technical journals or in the proceedings of various technical organizations. Some of these publications, issued through Government sources, had a circulation exceeding 5,000 copies, while others, issued in the technical press, had much wider circulation.

These papers covered a wide variety of subjects on health and safety in the mineral industries, including explosions, fires, falls of men and material, haulage, explosives, dusts, gases, petroleum, first aid, mine rescue, bonuses, lighting, coal mining, and metal mining.

One of the important auxiliary activities of the Safety Division of the Bureau of Mines is the Joseph A. Holmes Safety Association, an organization that gives awards for heroic action to persons in the mining and allied industries and also awards for exceptionally good safety records to persons or organizations in the mineral industries. The making of the awards for exceptional safety records with subsequent publication of the reasons for making the awards has stimulated safety in mining remarkably through efforts made to obtain awards by individuals or agencies that haven't had them, or to obtain additional awards by those who have previously received an award. More than 100 of these awards have been made annually for the past several years. The Joseph A. Holmes Safety Association is a different organization from the Holmes Safety Association; the former makes awards as above described, the latter is the organization that establishes safety clubs at mining communities.

Members of the Safety Division contribute much time and effort in committee and other types of work with organizations devoted in whole or in part to health and safety in mining, such as the National Safety Council, the American Mining Congress, the Mine Inspectors Institute of America, the Coal Mining Institute of America, the National Fire Protection Association, the American Standards Association, the American Institute of Mining and Metallurgical Engineers, and others. Assistance is given to State and Federal agencies in the preparation of safety laws, codes, regulations, inspections, etc. From its main offices in Washington and Pittsburgh, as well as from the various field stations, thousands of inquiries on health and safety in the mineral industries are answered, some of them requiring days or even weeks of research to obtain the desired data. In fact, the Bureau acts as a sort of clearing house for the assembling and disseminating of information on health and safety in mining.

## RESULTS OF THE BUREAU'S SAFETY ACTIVITIES IN COAL MINING

What is the net result of the efforts of the Federal Bureau of Mines to advance the cause of health and safety in the mineral industries? This cannot be answered readily; but if it is conceded, as it should be, that the Bureau's work has been responsible for some of the safer mining practices adopted since the Bureau was created in 1910, it must be admitted that it has used its influence to improve the condition of those engaged in work in the mineral industries. As has been indicated, the occurrence of major disasters in coal mines of the United States has been reduced nearly 80 percent, and the fatalities from major disasters have been reduced more than 90 percent since the Bureau came into existence. It is believed that the use of rock-dusting methods, brought about largely through the efforts of the Bureau, has prevented the loss of at least 200 lives annually during the past 10 or 12 years by preventing widespread explosions.

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From 1906 to 1910, inclusive (or just previous to the creation of the Bureau of Mines), 13,288 persons were killed in the coal mines of the United States, an average of 2,658 per year, and the fatality rate for this 5-year period was 5.89 persons killed per million tons of coal produced. From 1932 to 1936, inclusive, (the last 5-year period for which complete statistics are available) there were 6,077 fatalities in our coal mines, the rate being 2.93. This is a reduction of about 55 percent in the number of fatalities and of almost exactly 50 percent in the fatality rate as compared with the 5-year period 1906-1910. The number killed in our coal mines in 1932 was 1,207, and the fatality rate per million tons of coal produced was 3.36; in 1933, 1,064 were killed, a rate of 2.78; in 1934 there were 1,222 deaths, a rate of 2.93; and in 1935 there were 1,242 deaths, a rate of 2.93. Statistics for 1936 indicate that 1,342 fatalities occurred, a fatality rate of 2.73, the lowest coal-mining fatality rate on record; tentative figures for 1937 show that there were 1,412 fatalities, a rate of 2.85, and tentative figures for 1938 show 1,128 fatalities, a rate of 2.92.

If the 5.89 fatality rate for the 5-year period 1906-1910 had continued to the first of January 1939, the number of fatalities in the coal mines of the United States would have been almost 29,000 greater than they actually were; hence, during the 28-year life of the Bureau of Mines the coal-mine fatality rate has been reduced enough to indicate an average annual saving of life of more than 1,000 persons; similar figures as to prevention of nonfatal accidents are not available, but it is estimated that about 50 nonfatal accidents occur to one fatality, hence it is probable that about 50,000 nonfatal accidents also have been prevented annually. If the cost to the operator of a life is put into dollars and cents and a relatively low amount, such as $5,000, is taken as the "value" of life, it will be seen readily that, irrespective of ethical or humanitarian considerations (and not considering nonfatal accidents), the annual saving of somewhat more than 1,000 lives may be considered as "worth" more than $5,000,000, or almost three times the total amount being expended by the Bureau of Mines during the present fiscal year and nearly double the entire expenditure of the Bureau for any year of its existence. If, in addition, it is conceded that as many as 50,000 nonfatal accidents per year have been prevented (and the assumption is by no means unreasonable) and the "cost" to the operator in compensation, hospitalization, etc., of a nonfatal accident is placed at $100 (some authorities estimate it at $300), it will be seen that at least an additional $5,000,000 annually has been saved to the coal industry through the safer operation of the past 28 years.

The benefits to workers in and around coal mines due to this greater afety of operation are much more impressive than are those to the mine perator. Preventing the death of 29,000 coal-mine workers in the past 28 years obviously has avoided a vast amount of suffering, pain, and misery of arious kinds to the families who would have been bereft of their loved ones. oreover, the prevention of 50,000 or more nonfatal accidents annually for 8 years certainly has saved the miners, their families, and the community a arge amount of pain, inconvenience, misery, and other losses.

The financial losses that the workers have avoided through this greater safety in coal-mine operation are in themselves very great. The average age of the coal-mine worker who is killed is about 35 years, whereas under normal conditions he should have a future active working period of at least 20 years more. In normal times he should earn at least $1,000 annually; hence, in his 20 years of active life expectancy he would receive approximately $20,000 for his services. The saving of the life of about 29,000 coal-mine workers in the past 28 years through lowering the death rate in coal mining has therefore prevented a financial loss to them of at least $580,000,000; and this does not account for the financial losses to workers avoided through elimination of large numbers of nonfatal accidents. Hence, for the past 28 years an annual saving of approximately $21,000,000 has been made to coal-mine workers in the prevention of fatalities; $21,000,000 is far more than the total expenditures on safety work made by the Bureau of Mines since its establishment in 1910, therefore coal-mine workers unquestionably are reaping annual dividends of several hundred (probably several thousand) percent on the expenditures of the Federal Government in the promotion of safety in coal mining.

Table 1 on "Fatalities and Fatality Rates Per Million Tons of Coal Mined" for 1906 to 1938, inclusive, shows impressively the gradual and fairly constant decline in the number of fatalities as well as in the fatality rate in the coal mines of the United States. It will be noted that in 1933 there were but 1,064 fatalities in the coal mines of the United States, the smallest number in the period covered by the table for 1906-1938, inclusive. It will also be noted that the lowest fatality rate in this period (2.73 fatalities per million tons produced) was established in 1936, and in that year the tonnage was 491,133,762; the number of fatalities that year (1,342) is materially lower than the 2,821 fatalities in 1910, when essentially the same amount of coal was produced (501,596,378 tons), showing very impressively the much safer operation of our coal mines in recent years as compared with 1910, when the Bureau of Mines started its accident-prevention crusade. The table also shows that not only the number of coal-mine fatalities but also the coal mining-fatality rate have been far lower every year since 1930 than either was in any year previous to 1930, thereby indicating strongly that the progress in coal-mine safety is not merely temporary but is definitely and permanently established, with the probability of achievement of even great improvement in the future.

TABLE 1. - Fatalities and fatality rates per million tons of coal mined 1906-1938 inclusive

| Year | Number of fatalities (anthracite plus bituminous) | Deaths per million tons of coal produced | Tonnage (anthracite plus bituminous) |
|---|---|---|---|
| 1906 | 2,138 | 5.27 | 405,955,888 |
| 1907 | 3,242 | 6.78 | 477,892,536 |
| 1908 | 2,445 | 5.97 | 409,309,857 |
| 1909 | 2,642 | 5.73 | 460,807,263 |
| 1910 | 2,821 | 5.62 | 501,596,378 |
| 1911 | 2,656 | 5.35 | 496,371,126 |
| 1912 | 2,419 | 4.53 | 534,466,580 |
| 1913 | 2,785 | 4.89 | 570,048,125 |
| 1914 | 2,454 | 4.78 | 513,525,477 |
| 1915 | 2,269 | 4.27 | 531,619,487 |
| 1916 | 2,226 | 3.77 | 590,098,175 |
| 1917 | 2,696 | 4.14 | 651,402,374 |
| 1918 | 2,580 | 3.80 | 678,211,904 |
| 1919 | 2,323 | 4.19 | 553,952,259 |
| 1920 | 2,272 | 3.45 | 658,264,932 |
| 1921 | 1,995 | 3.94 | 506,395,401 |
| 1922 | 1,984 | 4.16 | 476,951,121 |
| 1923 | 2,462 | 3.74 | 657,903,671 |
| 1924 | 2,402 | 4.20 | 571,613,400 |
| 1925 | 2,234 | 3.84 | 581,869,890 |
| 1926 | 2,518 | 3.83 | 657,804,437 |
| 1927 | 2,231 | 3.73 | 597,853,916 |
| 1928 | 2,176 | 3.78 | 576,093,039 |
| 1929 | 2,187 | 3.59 | 608,816,788 |
| 1930 | 2,063 | 3.84 | 536,911,136 |
| 1931 | 1,463 | 3.31 | 441,750,978 |
| 1932 | 1,207 | 3.36 | 359,565,093 |
| 1933 | 1,064 | 2.78 | 383,171,877 |
| 1934 | 1,222 | 2.93 | 416,536,313 |
| 1935 | 1,242 | 2.925 | 424,632,005 |
| 1936 | 1,342 | 2.73 | 491,138,762 |
| 1937 | 1/1,412 | 1/2.85 | 1/494,200,000 |
| 1938 | 1/1,128 | 1/2.92 | 1/385,700,000 |

1/ Tentative, as estimated Jan. 4, 1939, by W. W. Adams, Employment Statistics Section, Bureau of Mines. These figures are likely to vary but slightly from the final figures, which will not be available for several months.

## RESULTS OF THE BUREAU'S SAFETY ACTIVITIES IN METAL MINES AND QUARRYING

The foregoing detailed facts about coal mining are more or less similar those relative to safety conditions that obtain in the other phases of e mining and allied industries, including metal mines, nonmetallic mineral nes, the petroleum industry, etc., all of which still have a relatively high rate of accident occurrence, though much progress has been made in the past 5 or 6 years even though the rates for 1937 and 1938 are likely to be higher than those of 1933 to 1936.

Table 2, "Accident Rates in Coal and Metal Mines and Quarries in the United States, 1911-38, Inclusive", gives in compact assembled form the story of the great drop in the accident rate in all kinds of mining and quarrying since 1911, the first year after the Bureau of Mines came into existence. The coal-mining rate has been discussed in connection with the previous tabulation on coal mining alone. The tabulation of interesting safety data on coal and metal mining and quarrying is more than ordinarily interesting in showing that while there was a more or less gradual decline in accident rates in these three branches of the mineral industry year by year, from 1910 to date, the real "break" to relatively low rates of accident occurrence in all three began in 1930 or 1931 and attained its greatest impetus in coal mining in 1933.

The rates given in table 2 are on a tonnage fatality basis for coal mining, because nonfatal-accident data for coal mines of the United States were unavailable until 1930. It is entirely probable, also, that the nonfatal-accident data in metal mining and quarrying were far from inclusive in the early years covered by the tabulation, and there is good reason to believe that if accidents of all kinds, fatal as well as nonfatal (but especially nonfatal), were reported as fully in the period 1911 to 1920 for metal mining and quarrying as they now are, the accident rates would have been shown as much higher than those given in the tabulations and, by comparison, the present rates for those industries would show much better than they now do. This is substantiated by the fact that the metal-mining fatality rate in the 5-year period 1911-15 was 4.01, in 1916-20 it was 3.70, and it fell to 3.22 in 1921-25, to 3.02 in 1926-30, and to 2.51 in 1931-35, so that the fatality rate decrease in metal mining has been almost as great as in coal mining.

TABLE 2. - Accident rates in coal and metal mines and quarries, in the United States, 1911-38, inclusive

| Year | Coal mining-fatality rate per million tons produced | Number killed and injured in metal mines per thousand 300-day workers (calculated) | Number killed and injured in quarries per thousand 300-day workers (calculated) |
|---|---|---|---|
| 911-15 .......... | 4.76 | 202.38 | 91.58 |
| 916-20 .......... | 3.84 | 245.04 | 162.39 |
| verage 1911-20, inclusive ...... | 4.27 | 224.36 | 123.84 |
| 921-25, inclusive | 3.96 | 276.27 | 175.22 |
| 926-30, inclusive | 3.75 | 213.22 | 140.77 |
| 931-35 .......... | 3.06 | 150.51 | 95.74 |
| 926 ............. | 3.83 | 248.48 | 162.15 |
| 927 ............. | 3.73 | 224.64 | 164.55 |
| 928 ............. | 3.78 | 208.11 | 131.41 |
| 929 ............. | 3.59 | 203.14 | 129.79 |
| 930 ............. | 3.84 | 170.78 | 109.76 |
| 931 ............. | 3.31 | 142.09 | 106.04 |
| 932 ............. | 3.36 | 138.46 | 97.33 |
| 933 ............. | 2.78 | 155.13 | 97.59 |
| 934 ............. | 2.93 | 163.17 | 91.18 |
| 935 ............. | 2.925 | 152.86 | 86.23 |
| 936 ............. | 2.73 | 176.71 | 92.32 |
| 937 ............. | 1/ 2.85 | (2/) | 95.12 |
| 938 ............. | 1/ 2.92 | (2/) | (2/) |

/ Tentative.
/ Not available.

## CONCLUSIONS

Unquestionably, much progress has been made in eliminating health and fety hazards in the mineral industries since the Bureau of Mines was stablished in 1910, and there is absolutely no doubt that a considerable ount of the improvement is due to the fact that the Federal Bureau of nes, through its numerous health and safety activities, acted as what ght be termed a "sparkplug" in keeping safety to the front. There is also question that much remains to be done before our mines can be considered being operated with anything like the degree of safety that can and should reached. Unquestionably, mine-accident occurrence can be reduced at least percent (possibly as much as 75 percent) below what it now is, and this n be accomplished readily if the various interested agencies - the mine erators, the workers, the State inspection departments, the safety workers the Federal Bureau of Mines, and others engaged in mine-safety work - operate as they can and should to make mining a relatively safe occupation.

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